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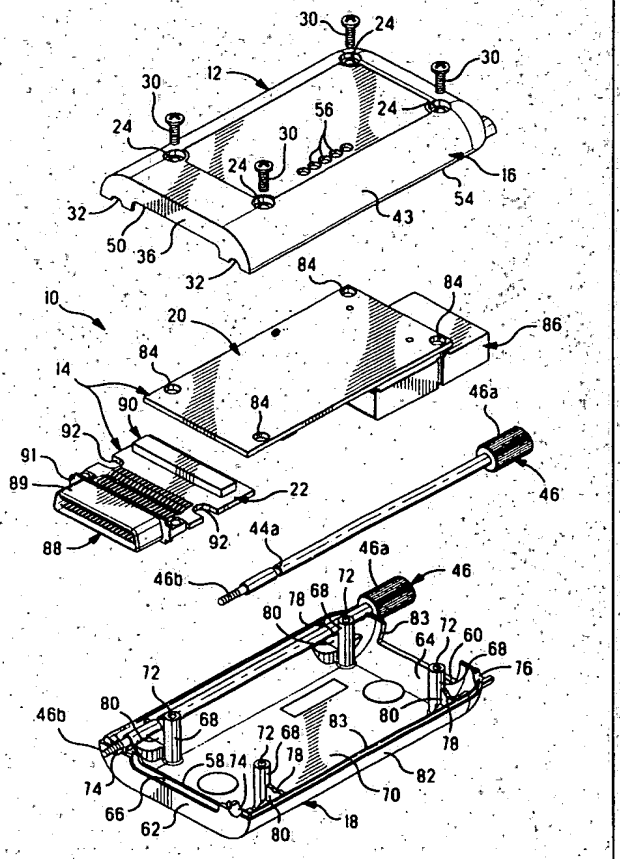
(54) Title: ELECTRICAL CONNECTOR HOUSING FOR CIRCUIT BOARD ASSEMBLY

(57) Abstract

An electrical housing (12) for a circuit board assembly (14) comprises interfitting upper and lower housing members (16, 18) along which the circuit board assembly is disposed when the housing members are fitted and secured together. One end of the housing members (16, 18) has connector-receiving recesses (50, 58) in which an electrical connector (88) on the circuit board assembly is disposed for positioning the circuit board assembly longitudinally relative to the housing members. Vertical positioning members (26, 68) on the housing members are provided for vertically positioning the circuit board assembly within the housing members. Jack screw-positioning members (32, 34, 40; 74, 76, 78) are provided by the housing members (16, 18) for positioning jack screws (46) within the housing members (16, 18) and maintaining the jack screws therein so that they are captured therein.



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ELECTRICAL CONNECTOR HOUSING FOR CIRCUIT BOARD ASSEMBLY

The present invention relates to electrical housings and more particularly to electrical housings for circuit board assemblies.

Media Independent Interface (MII) Transceivers are used to connect workstations to Fast Ethernet hubs, switches and routers. These transceivers typically include circuit board assemblies having interconnected mother and daughter boards or mother boards on which electrical connectors or electrical connectors and fiber optic connectors are provided. The circuit board assemblies are mounted in electrical housings having jack screws for mounting the transceivers to hubs and switches. The electrical housings used in these transceivers are stamped and formed from metal sheets resulting in large-size housings that are bulky and require a lot of metal to make. The assembly of the various parts to form the transceivers is very difficult because of the number of parts involved and alignment of the parts in the housing is also difficult. These operations are time consuming, thereby increasing the cost of the transceivers. Moreover, the jack screws are floatably mounted in the housings and not captured therein. In another type of transceiver, a one-piece extruded housing is used which is not capable of securely clamping the circuit board assembly therein, because the circuit board assembly is slid into the housing and not accurately placed therein.

Accordingly, a need arose to provide an electrical housing that would enable circuit board assemblies to be easily positioned and aligned therein in an efficient and cost-saving manner.

In addition, there has been a need to provide an electrical housing with jack screws captured therein so that they would not float and remain in place.

The transceiver of the present invention provides a housing adapted for accurate positioning of the circuit board and its connectors therein, and holding the jackscrews therein in a manner permitting rotation thereof. Upper and lower housings interfit, having positioning members for vertically positioning the circuit board assembly within the housing members, and for establishing ground connections with the circuit board.

In one embodiment, one end of the housing members has connector-engaging portions for engaging the electrical connector on the circuit board assembly for positioning the circuit board assembly longitudinally relative to the housing members and maintaining the connector in position therebetween.

In another embodiment, each housing is extruded such as of aluminum and then cut to length, and also the housings may be hermaphroditic. Separate end members secured to housing ends have connector-engaging portions for engaging the connectors on the circuit board assembly for positioning the circuit board assembly longitudinally relative to the housing members and maintaining the connectors in position therebetween.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is an isometric exploded view of a Media Independent Interface Transceiver including a circuit board assembly, an electrical housing therefor and jack screws;

FIGURE 2 is a isometric view showing FIG. 1 in an assembled form;

FIGURE 3 is a isometric and exploded view of an upper housing member and a lower housing member of the electrical housing;

FIGURE 4 is a cross-sectional view taken along line 4-4 of FIG. 2;

FIGURES 5 and 6 are exploded and assembled perspective views of another embodiment of Media Independent Interface Transceiver;

FIGURE 7 is an enlarged cross-sectional view of a forward end of a jack screw secured within an end member of the electrical housing;

FIGURE 8 is a cross-sectional view taken along line 8-8 of Figure 6; and

FIGURE 9 is a part cross-sectional view similar to Figure 7, of an alternative embodiment of transceiver.

As shown in FIGS. 1 to 4, a Media Independent Interface (MII) Transceiver 10 comprises a metal housing 12 and a circuit board assembly 14. The MII Transceiver is to be used to connect workstations, switches or hubs to other Fast Ethernet workstations, hubs and switches. While the present invention relating to the electrical housing is used in conjunction with the circuit board assembly forming the electronic circuits of the transceiver, other circuit board assemblies for other electronic circuits can be housed in the electrical housing.

Electrical housing 12 includes an upper housing member 16 and a lower housing member 18, which interfit with one another; circuit board assembly 14 includes a mother board 20 and a daughter board 22.

Upper housing member 16 and lower housing member 18 are formed as metal die cast members in accordance with conventional metal die cast practices and the metal used is preferably zinc.

Upper housing member 16 has counter sunk holes 24 extending through raised members 26 on an inside surface 28 of upper housing member 16. Holes 24 receive screws 30 for securing housing members 16,18 together (FIG. 2). Arcuate recesses 32,34 are located at outer ends of a front wall 36 and a rear wall 38 of upper housing member 16. Arcuate recesses 40 (FIG. 3) are also located in extensions 42 extending inwardly from the side walls 43

of upper housing member 16 adjacent to and in alignment with front raised members 26. Arcuate recesses 32,34,40 along each side of upper housing member 16 are aligned for accommodating shafts 44 of jack screws 46. A groove 48 is located in a U-shaped recess 50 in front wall 36. A U-shaped recess 52 is also located in rear wall 38. An outer flange 54 extends along the inner edges of the front, side and rear walls of upper housing member 16. A series of holes 56 extend through the upper housing member 16 in alignment with LEDs (not shown) on the mother board of the circuit board assembly 20 to indicate operating status.

Lower housing member 18 has U-shaped recesses 58,60 in front and rear walls 62,64, respectively. A groove 66 is located in U-shaped recess 58. Circuit board columnar mounting members 68 extend inwardly from an inside surface 70 of lower housing member 18 in alignment with holes 24 of the upper housing member 16, and mounting members 68 have threaded holes 72 thereinto to receive the threaded shanks of screws 30 to secure the housing members together as well as to mount and secure the circuit board assembly 14 therebetween (FIG. 4). Threaded holes 72 are threaded by a conventional rolling operation to preclude formation of any metal chips that could effect the operation of the electronic circuits. Arcuate recesses 74,76 are located at outer ends of front and rear walls 62,64, respectively, of lower housing member 18. Arcuate recesses 78 are also located in extensions 80 extending inwardly from the side walls 82 of lower housing member 18 in alignment with respective mounting members 68. Arcuate recesses 74,76,78 of lower housing member 18 are aligned with arcuate recesses 32,34,40 of the upper housing member 16 and these aligned recesses accommodate shafts 44 of jack screws 46 when housing members 16,18 are secured together. Annular grooves 44a in shafts 44 are disposed in opposed arcuate recesses 40,78 of upper and lower

housing members 16,18 which act to capture the jack screws 46 thereby preventing them from floating and being removed unless the housing members are separated. An inner flange 83 extends along the inner edges of the front, side and rear walls of lower housing member 18. Inner flange 83 overlaps with outer flange 54 of upper housing member 16 when housing members 16,18 are secured together to prevent EMI and RFI leakage.

Mother board 20 on which the electronic circuits are located has plated-through holes 84 at the corners and a fiber optic connector 86 disclosed in U.S. Patent No. 5,386,487 is mounted at an outer end thereof. Alternatively, connector 86 can be an electrical connector of the type disclosed in U.S. Patent No. 4,221,485. Plated-through holes 84 are arranged for alignment and engagement with mounting members 68 and 26 when the circuit board assembly 14 is positioned in lower housing member 18; and when the housing members 16, 18 are secured together via screws 30 between mounting members 68 and raised members 26, as shown in FIG. 4, a ground connection is made between the housing 12 and the circuit board assembly 14.

Daughter board 22 has shielded electrical connector 88 mounted at an outer end, and one half of a conventional stacking electrical connector 90 mounted at an inner end which mates with the other half (see FIG. 4) which is mounted at an inner end of mother board 20, thereby electrically interconnecting the circuit boards 20, 22. Circuit paths on daughter board 22 interconnect the electrical contacts between connectors 88,90. Connector 88 may be an AMPLIMITE connector sold by AMP Incorporated, Harrisburg, PA having Part No. 749556.

Daughter board 22 has opposed recesses 92 between connectors 88,90 for registration with respective mounting members 68 on lower housing member 18 when the circuit board assembly is positioned therein, thereby

assisting in the longitudinal arrangement of the circuit board assembly in the housing 12.

Shield 89 of connector 88 has a peripheral flange 91 that is disposed in groove 66 in U-shaped recess 58 of lower housing member 18 when the circuit board assembly 14 is positioned therein, and flange 91 also is disposed in groove 48 of U-shaped recess 50 of the upper housing member 16 when housing members 16,18 are secured together. Disposition of flange 91 in groove 66 and recesses 92 along mounting members 68 positions circuit board assembly 14 longitudinally along lower housing member 18.

Connector 86 is located in recesses 52,60 of housing members 16,18 and between mounting members 68 adjacent recess 60, and connector 88 is disposed in recesses 50,58 of housing members 16,18 when the housing members are secured together.

To assemble the circuit board assembly 14 into housing 12 to form a Media Independent Interface Transceiver 10, circuit board assembly 14 is positioned in lower housing member 18 by moving the circuit board assembly 14 vertically downward toward lower housing member 18 with flange 91 being disposed in groove 66 while the front part of connector 88 is positioned in recess 58. Simultaneously, recesses 92 of daughter board 22 slide along mounting members 68 until plated through holes 84 of mother board 20 rest on the upper ends of mounting members 68 and a rear part of connector 86 is positioned between mounting members 68 while a front part of connector 86 is disposed in recess 60. As shown in FIG. 4, upper ends of mounting members 68 extend above a plane containing the flange 83 so that daughter board 22 is located centrally of housing 12 and mother board 20 extends along a plane parallel with but spaced slightly inward from inner surface 28 of upper housing member 16.

Shafts 44 of jack screws 46 are disposed in arcuate recesses 74,76 while annular grooves 44a are disposed in arcuate recesses 78 of lower housing member 18 leaving operating members 46a and threaded sections 46b of jack screws 46 extending outwardly from respective ends of the lower housing member 18 and housing 12 (see FIG. 2).

Upper housing member 16 is then placed onto lower housing member 18 with recesses 50,52 encompassing the front parts of connectors 88,86 and inner and outer flanges 54,83 overlapping one another. Screws 30 are then placed in holes 24 of upper housing member 16, plated-through holes 84 of mother board 20 and threaded holes 72 of mounting members 68 and tightened, thereby securing housing members 16,18 together and maintaining the circuit board assembly 14 in position within housing 12. As pointed out above, plated-through holes 84 form a ground connection with housing 12.

In another embodiment shown in FIGS. 5 to 8, electrical housing 112 includes an upper housing member 116 and a lower housing member 118, that interfit with one another; circuit board assembly 114 includes a circuit board 120. Upper housing member 116 and lower housing member 118 are formed as extruded metal members in accordance with conventional metal extruding practices and the metal used is preferably aluminum, with the members preferably being hermaphroditic. Thus, a single extruding mold is used and the housing members are cut to the desired length and interfitted to form housing 112 to house circuit board assembly 114. Tooling cost is thus minimized.

Due to housing members 116,118 being of the same configuration, they will be described together. Each housing member 116,118, as shown in FIG. 8, comprises a wall 122 and side walls 124,126 which form a generally U-shape configuration in cross section. Part-circular recesses 128 are located at the corners of housing members 116,118 and outer and inner parallel projections

130 having tapered sides and planar outer surfaces extend along walls 122 to make the walls more rigid and strong. Side walls 124 have inwardly-directed platforms 132, and side walls 126 also have inwardly-directed platforms 134.

Platforms 132 have an outer recess 136, an inner recess 138 and an arcuate recess 140 disposed therebetween which faces outwardly in the same direction as outer recess 136. Inner recess 138 faces inwardly and is disposed normal to outer recess 136. Outer and inner recesses 136,138 have tapered surfaces opposite respective vertical and horizontal surfaces. A projection 142 extends above the surface containing arcuate recess 140 and is spaced inwardly therefrom.

Platforms 134 have outer and inner projections 144, 146 which are disposed normal to one another. An arcuate recess 148 is located between projections 144,146. A planar surface 150 connects arcuate recess 148 and inner projection 146. Outer projection 144 has tapered and vertical surfaces.

Circuit board 120 of the circuit board assembly 114 has an electrical connector 152 connected to one end and a fiber optic connector 154 connected to the other end. Fiber optic connector 154 is disclosed in U.S. Patent No. 5,386,487 and electrical connector 152 is of the type identified as Part No. 174218-2 of AMP Incorporated, Harrisburg, PA.

Turning to FIG. 5, circuit board assembly 114 is positioned in housing 112 and secured between housing members 116,118 via end members 156,158 which abut against the ends of housing members 116,118. Screws 160 extend through holes 162 in end members 156,158, and they have thread-forming shanks that form threads in part-circular recesses 128 in housing members 116,118 without forming any metal chips, thereby securing the housing members 116,118 together to form housing 112.

End members 156,158 can be metal die cast members, plastic molded members or metal plates stamped from sheet metal.

Jack screws 164 have shafts 166 with threaded ends 168 and operating knobs 170 at opposite ends. Shafts 166 extend through holes 163 in end members 156,158 and through the openings formed by arcuate recesses 140,148 of platforms 132,134 when housing members 116,118 are assembled (see FIG. 8). Clips 169 of the Tinnerman-type are pressed on the ends of shafts 166 that protrude beyond end member 154 including the threaded ends, as shown in FIG. 7, with clips 169 seating in reduced diameter sections 171 of shafts 166 at least outwardly of housing 112, all thereby positioning, securing and capturing the jack screws 164 within the housing 112.

Slots 165 are provided in end members 156,158 to accommodate the outer ends of connectors 152,154 when end members 156,158 are secured to the respective ends of housing 112.

To assemble the circuit board assembly 114 into housing 112 to form a Media Independent Interface Transceiver 110, circuit board assembly 114 is positioned in lower housing member 118 as shown in FIG. 8 whereby one edge of circuit board 120 is disposed in inner recess 138 of platform 132 and a second edge of circuit board 120 is positioned on projection 146 of platform 134. Upper housing member 116 is then positioned in place on lower housing member 118 and circuit board 120 whereby outer projection 144 of platform 134 is received in outer recess 136 of platform 132 and projection 142 of platform 132 engages the second edge of circuit board 120 along the right hand side of FIG. 8. Along the left hand side of FIG. 8, outer projection 144 of platform 134 is disposed in outer recess 136 of platform 132.

End members 156,158 are secured to respective ends of housing 112 via thread-forming screws 160 extending

through holes 162 in end members 156,158 and form threads in respective part-circular recesses 128 in housing members 116,118. The outer ends of connectors 152,154 extend through slots 165 in the end members 156,158. Securing of end members 156,158 to housing members 116,118 secures housing members 116,118 together thereby forming housing 112 and positions the circuit board assembly 114 longitudinally within housing 112 with the outer ends of connectors 152,154 accessible for connection to mating connectors.

Shafts 166 of jack screws 164 are fed through holes 163 in end member 158 and through channels formed by opposing arcuate recesses 140,148 of opposing platforms 132,134 of housing members 116,118 until the threaded ends 168 are disposed in holes 163 of end member 156 and extend outwardly therebeyond. Clips 169 are pressed onto the protruding ends of shafts 166 seating in reduced diameter sections 171 outwardly of end member 156 (FIG. 7) for securing and capturing jack screws 164 within housing 112. This leaves operating knobs 170 and threaded ends 168 extending outwardly from respective end members 156,158.

The edges of circuit board 120 are provided with a ground circuit path which is electrically connected to housing 112 via projections 142,146 of platforms 132,134 thereby grounding circuit board 120 to housing 112.

The interfitting of housing members 116,118 via outer projections 144 within outer recesses 136 prevents EMI and RFI leakage. Platforms 132,134 provide positioning members for vertically positioning circuit board assembly 114 within housing members 116,118. End members 156,158 position circuit board assembly 114 longitudinally within housing 112.

FIG. 9 shows an alternative embodiment wherein shafts 166a of jack screws 164a have an annular groove 166b adjacent threaded ends 168a. An E-clip 169a is snapped into grooves 166b whereafter end member 156 is

secured to the end of housing 116 via screws 160 with threaded ends 168a extending through holes 163. Optionally, E-clips 169a could be disposed in recesses (not shown) along the inner surfaces of end member 156.

An important feature of the present invention is the capturing of jack screws in the housing, where the jack screws assist in the connection and disconnection of one of the connectors with its mating connector.

Another important feature of the present invention is that the shape of the housings enables connection of the transceivers to adjacent units without any interference.

A further feature of the present invention is the ease of assembly of the parts to form the transceivers thereby resulting in lower costs, and facilitates the transceivers being assembled by automation.

Also, in one of the embodiments, tooling required to manufacture the housings is minimal when compared with other techniques. For prototype and low volume housings, this is the most cost effective approach. An additional feature of this embodiment 112, is that the housing members 116,118 forming housing 112 are hermaphroditic thereby requiring only one extruding die to form both housing members.

WHAT IS CLAIMED IS:

1. An electrical housing (12,112) for a circuit board assembly (14,114) having at least one electrical connector (88,154) thereon comprising interfitting upper and lower housing members (16,18;116,118) along which the circuit board assembly is disposed when the housing members are fitted and secured together, one end of the housing members (16,18;116,118) having connector-engaging portions in which the electrical connector is disposed, and jack screws (46,164) mounted in the housing members, characterized in that:

first positioning members (26;142,146,150) are provided on the housing members (16,18;116,118) for vertically positioning the circuit board assembly (14,114) within the housing members,

second positioning members (68,92;156,158) are provided by the housing members (16,18;116,118) and the electrical connector for positioning the circuit board assembly (14,114) longitudinally relative to the housing members, and

jack screw-positioning members (32,34,40;74,76,78;169,169a) for positioning the jack screws within the housing members (16,18;116,118) and maintaining the jack screws in position therein so that the jack screws are operationally captured therein.

2. An electrical housing (12) as claimed in Claim 1, further characterized in that the jack screw-positioning members (32,34,40;74,76,78) are provided by the housing members (16,18).

3. An electrical housing (12) as claimed in Claim 2, further characterized in that said housing members (16,18) have flanges (54,83) along opposing edges that overlap when the housing members are interfitted and secured together.

4. An electrical housing (12) as claimed in Claim 2, further characterized in that said connector-engaging

portions comprise grooves (50,58) for receiving a flange (91) of the electrical connector (88).

5. An electrical housing (12) as claimed in Claim 2, further characterized in that said first and second positioning members comprise columnar mounting members (68) extending inwardly from an inside surface (70) of said lower housing member (18), and raised members (26) located on an inside surface (28) of said upper housing member (16) opposite respective columnar mounting members (68) between which the circuit board assembly (14) is disposed.

6. An electrical housing (12) as claimed in Claim 5, further characterized in that said columnar mounting members (68) and said raised members (26) form a ground connection with the circuit board assembly (14).

7. An electrical housing (12) as claimed in Claim 5, further characterized in that said columnar mounting members (68) extend above a plane containing the ends of the front, rear and side walls (62,64,82) of said lower housing member (18).

8. An electrical housing (12) as claimed in Claim 2, further characterized in that said jack screw-positioning members comprise aligned arcuate recesses (74,76) at outer edges of front and rear walls (36,38;62,64) of said housing members in which shafts (44) of the jack screws (46) are disposed.

9. An electrical housing (12) as claimed in claim 8, further characterized in that opposing extensions (42,80) are located on inside surfaces (28,70) of said housing members (16,18) and include further arcuate recesses (78) aligned with the arcuate recesses (32,34;74,76) in said front and rear walls (36,38;62,64), said further arcuate recesses receiving annular grooves (44a) of the shafts (44) of the jack screws (46) thereby capturing the jack screws with the housing members when they are secured together.

10. An electrical housing (12) as claimed in Claim 2, further characterized in that another end of the housing members (16,18) includes other connector-engaging portions (52,60) for engaging another connector (86) on the circuit board assembly (14).

11. An electrical housing (110) as claimed in claim 1, further characterized in that said jack screw-positioning members (169) are secured to the jack screws (164).

12. An electrical housing (112) as claimed in claim 11, further characterized in that said jack screw-positioning members are Tinnerman-type clips (169) pressed onto ends of said jack screw shafts (166) and seated within reduced diameter sections (171) thereat.

13. An electrical housing (112) as claimed in claim 11, further characterized in that said jack screw-positioning members are E-clips (169a) snapped into annular grooves in said jack screw shafts (166a).

14. An electrical housing (112) as claimed in claim 11, further characterized in that said housing members (116,118) are hermaphroditic and have walls (122) and side walls (124) forming a U-shape configuration.

15. An electrical housing (112) as claimed in claim 14, further characterized in that said walls (122) of said housing members (116,118) have inner and outer parallel projections (130) to make said walls more rigid and strong.

16. An electrical housing (112) as claimed in claim 14, further characterized in that the housing members (116,118) have part-circular recesses (128) for receiving thread-forming screws for securing end members (156,158) to the housing members (116,118).

17. An electrical housing (112) as claimed in claim 14, further characterized in that said positioning members comprise platforms (132,134) extending inwardly

from the side walls (124,126) of said housing members (116,118).

18. An electrical housing (112) as claimed in claim 17, further characterized in that said platforms (132,134) include outer projections (144) disposed within outer recesses (136) so that said housing members (116,118) interfit with one another.

19. An electrical housing (112) as claimed in claim 17, further characterized in that said platforms (132,134) have opposing arcuate recesses (140,148) defining channels along which said jack screw shafts (166) extend.

20. An electrical housing (112) as claimed in claim 17, further characterized in that one of the platforms (132) includes an inner recess (138) for receiving a first edge of a circuit board (120) of the circuit board assembly (114), another of the platforms (134) has an inner projection (146) on which a second edge of the circuit board is to be disposed, thereby securing the circuit board between said platforms and forming a ground connection therewith.

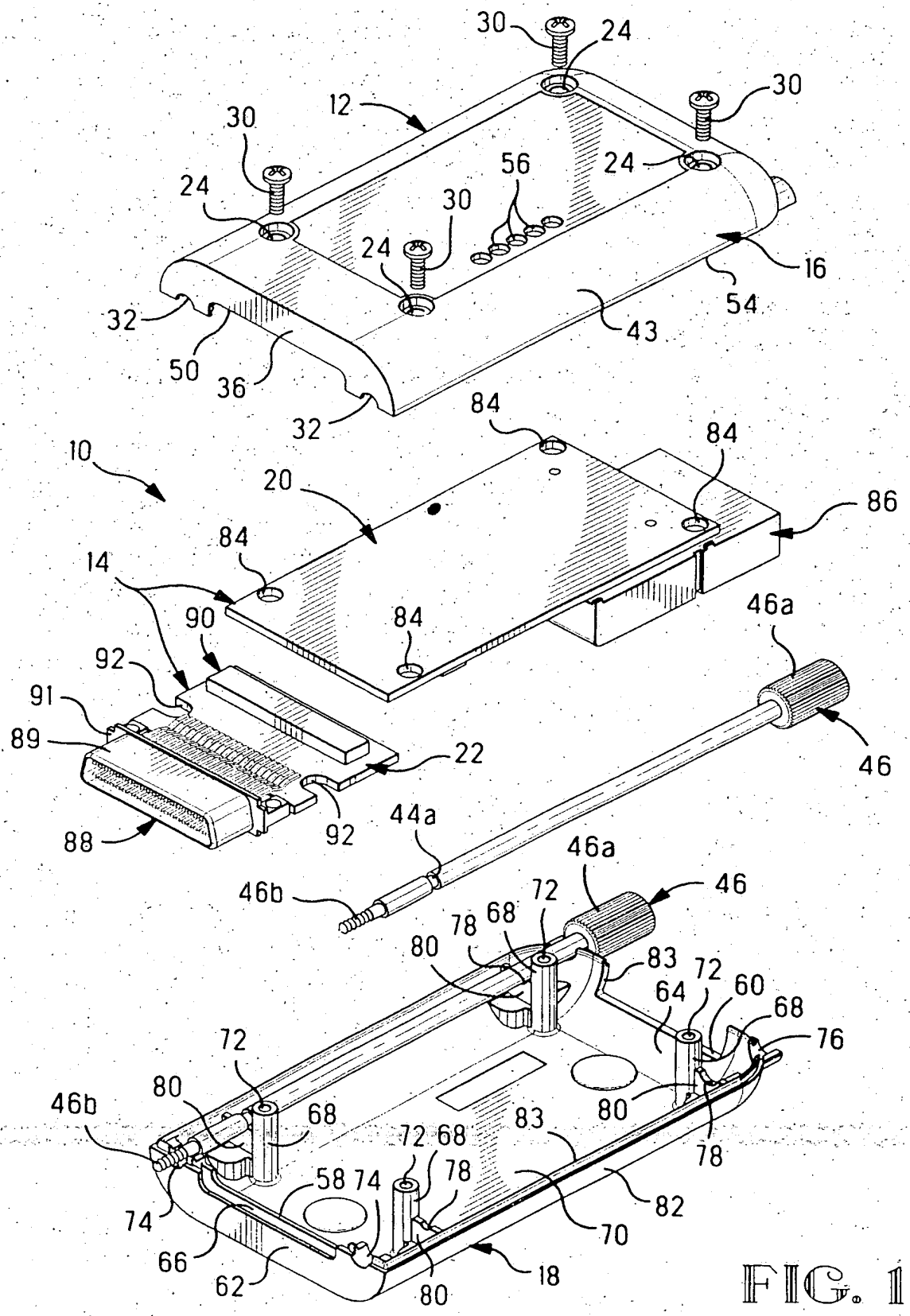

FIG. 1

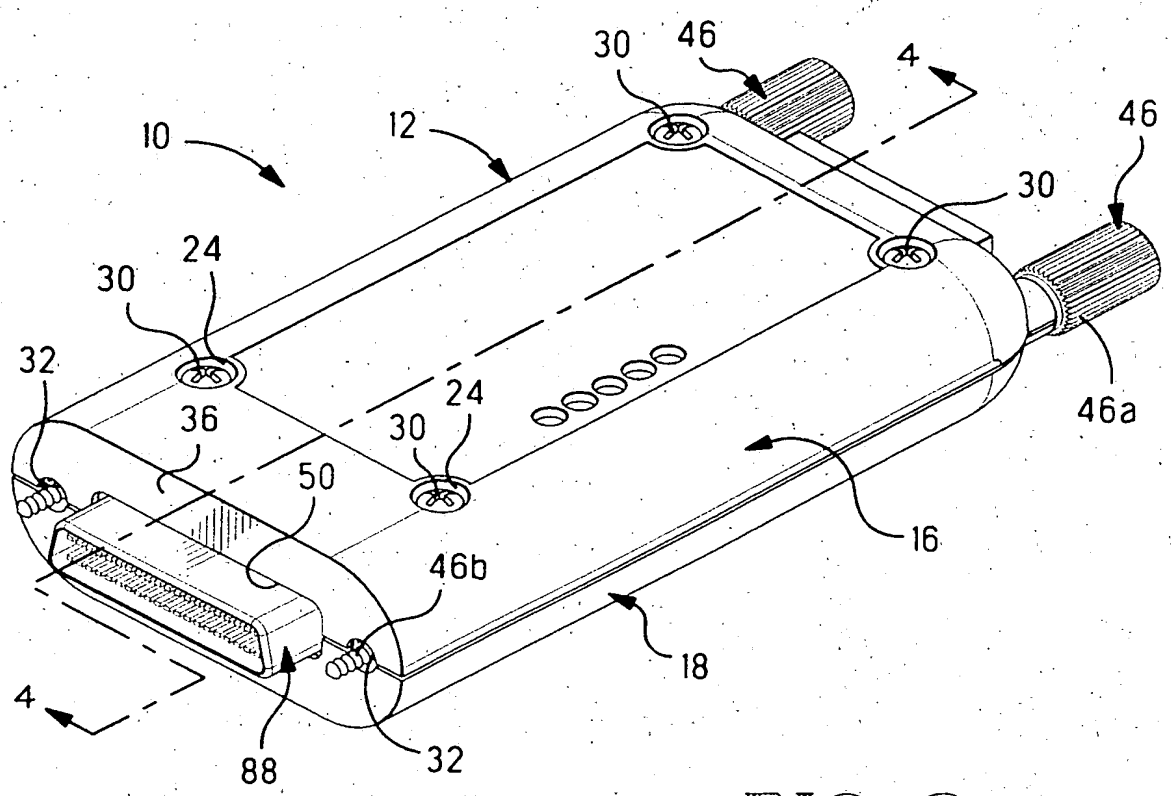

FIG. 2

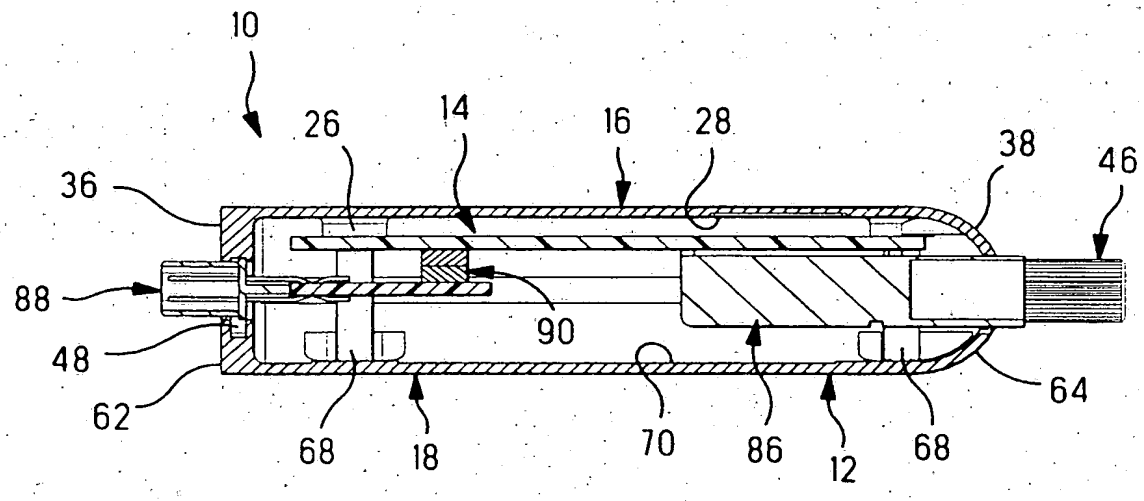

FIG. 4

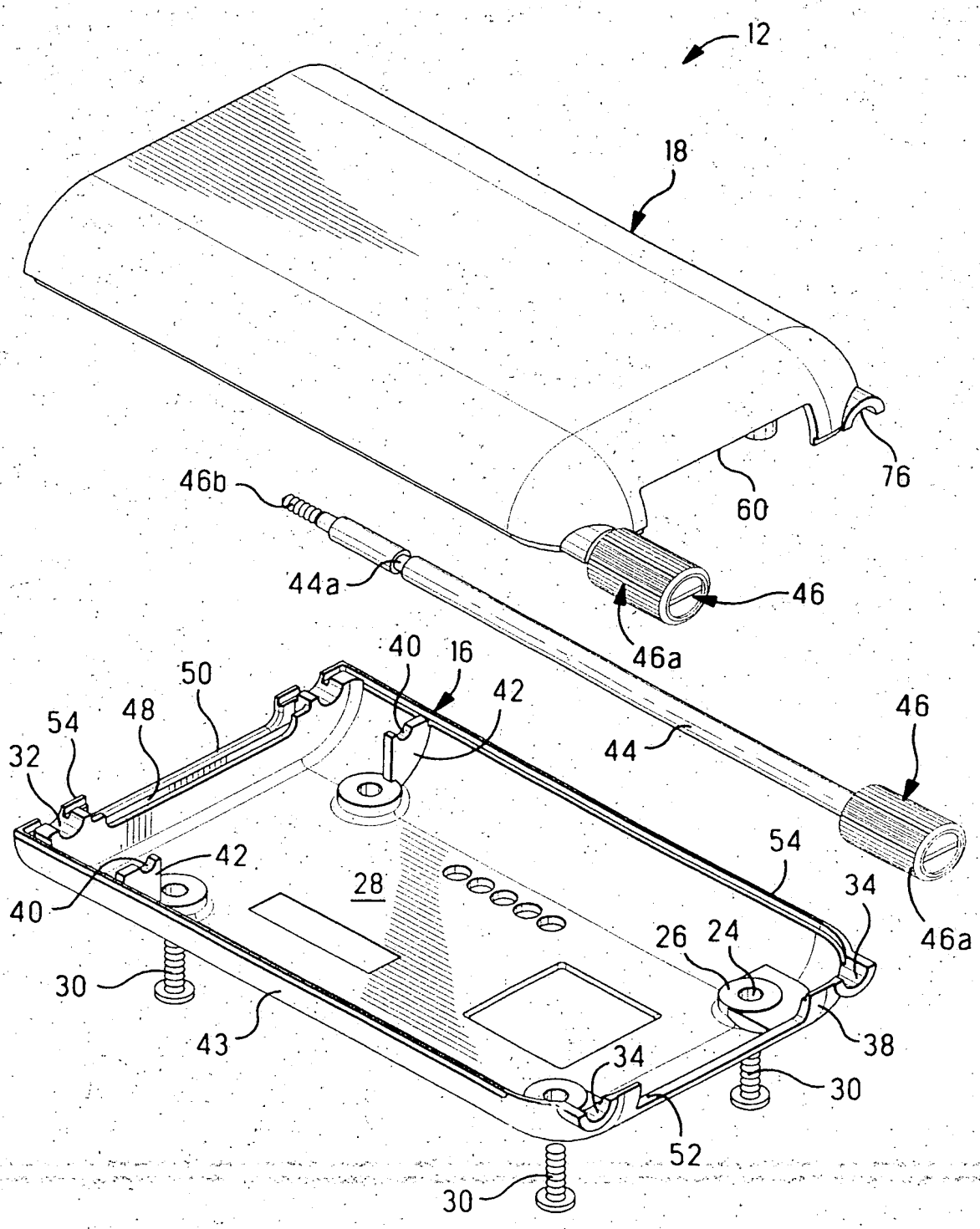

FIG. 3

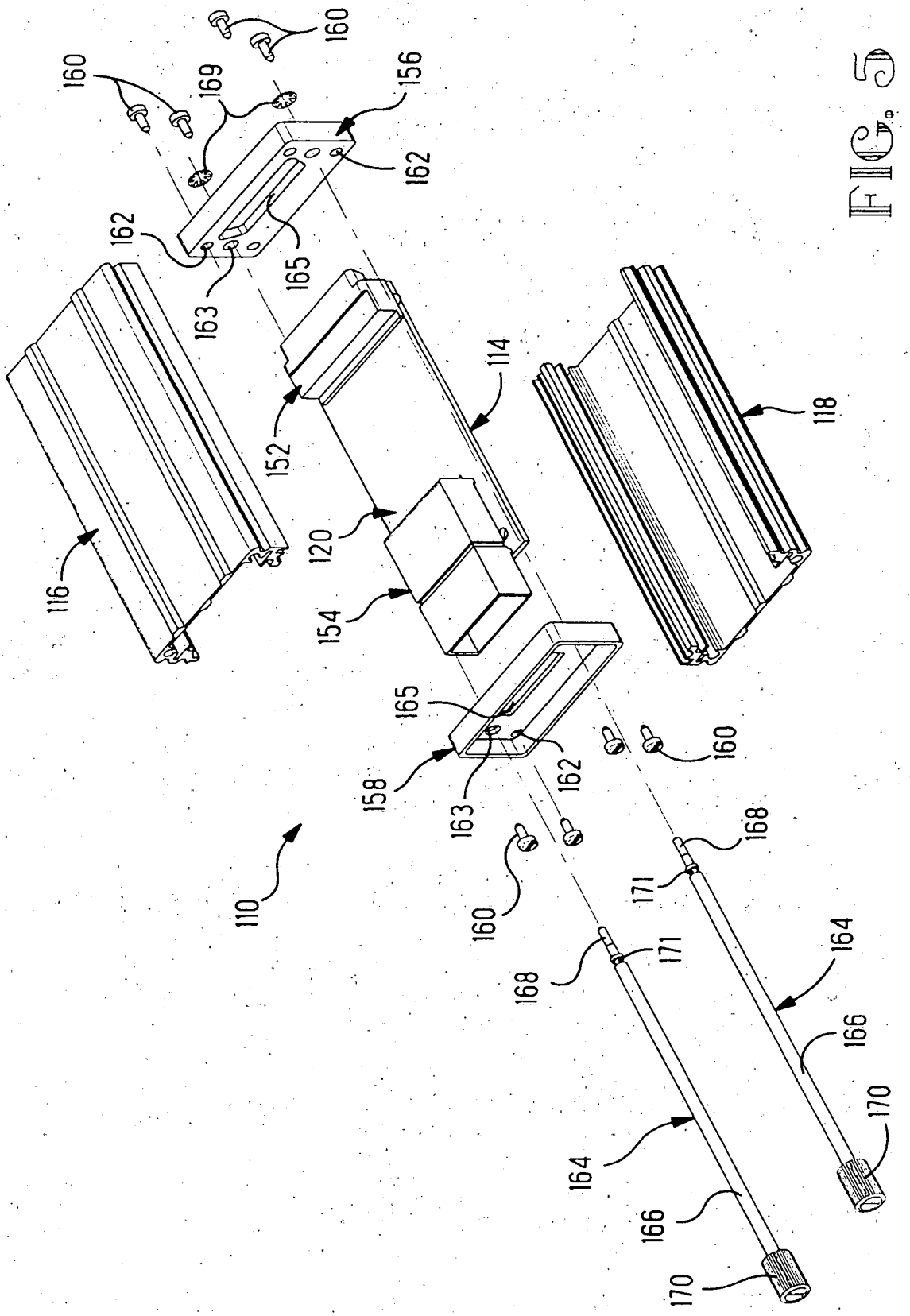

FIG. 5

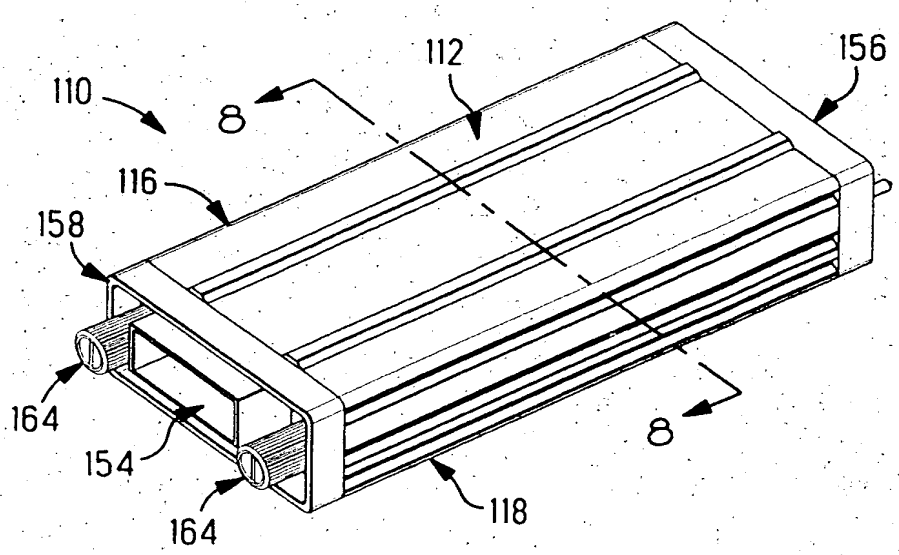

FIG. 6

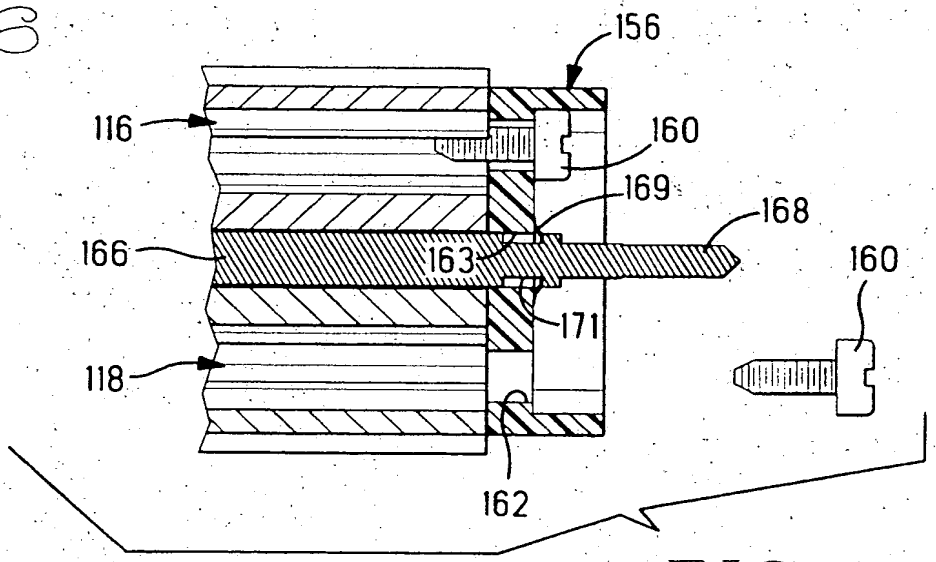

FIG. 7

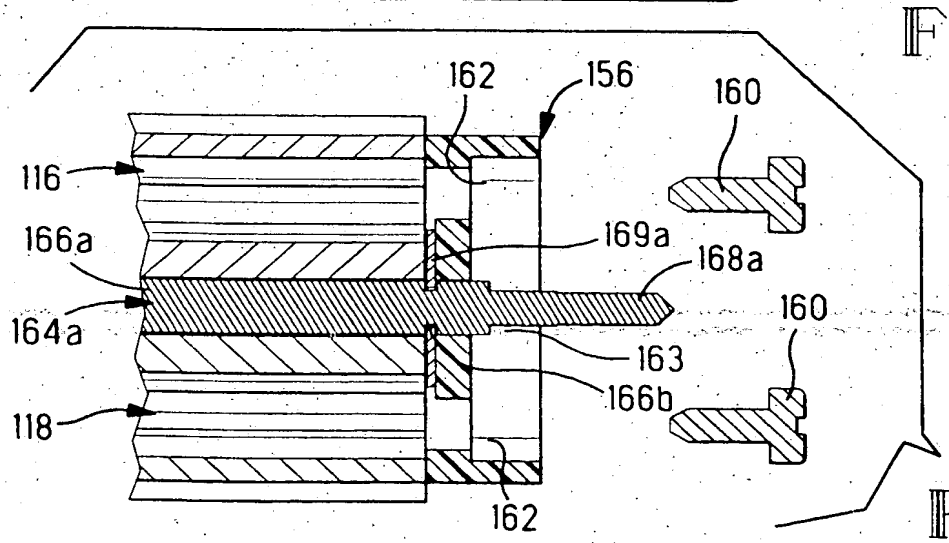

FIG. 9

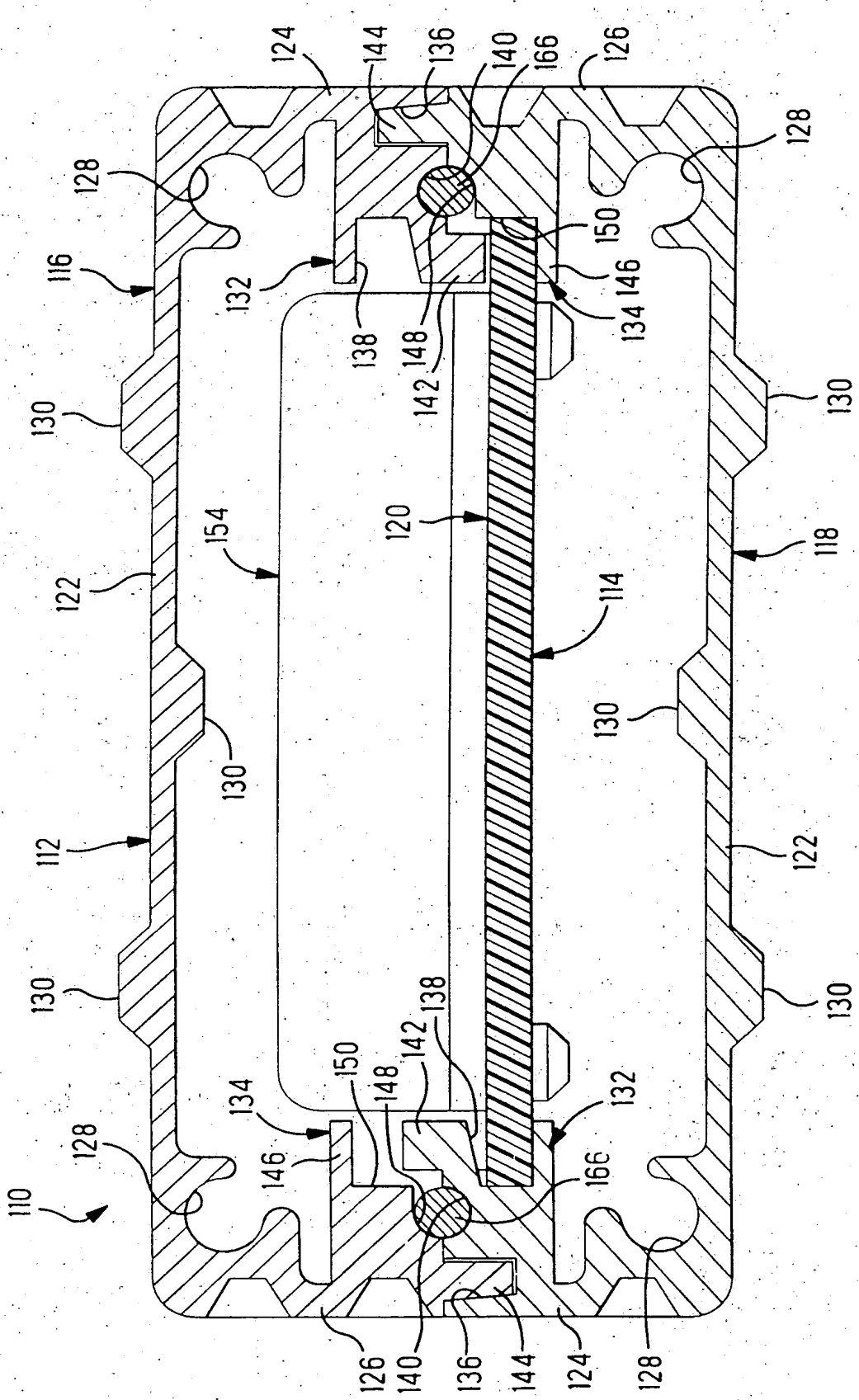

FIG. 8

INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/US 98/02360

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H05K5/00 H05K7/14 H01R13/66

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H05K H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 197 900 A (J.S.ELLIS ET AL) 30 March 1993 see column 1, line 7 - line 12	1,2,4,5, 10
A	see column 5, line 3 - line 40; figures 1-3	8,9

Y	US 5 217 394 A (M.C.HO) 8 June 1993 see column 3, line 47 - column 4, line 14; figures 3-5	1,2,4,5, 10

A	CH 531 801 A (SIEMENS) 31 January 1972 see column 3, line 9 - line 17; claim 1; figures 1,2	1,5

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 May 1998	18/05/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Alexatos, G

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INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/US 98/02360

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 668 715 A (DANA) 23 August 1995 see column 4, line 18 - column 5, line 5 see column 6, line 18 - column 7, line 31; figures 1,2	1,15-18

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ional Application No
PCT/US 98/02360

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5197900 A	30-03-93	NONE	
US 5217394 A	08-06-93	NONE	
CH 531801 A	15-12-72	NONE	
EP 668715 A	23-08-95	US 5461541 A	24-10-95